

**Preliminary Assessment
of
Winter Water Withdrawals
at
Selected U.S. Geological Survey
Stream Flow Gages**

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for the
Maine Department of Environmental Protection**

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Introduction:

This draft report compares the daily stream flow at two U.S. Geological Stream (USGS) stream flow gages in Western Maine to the seasonal withdrawal thresholds proposed in the draft water use rules prepared by the Maine Department of Environmental protection (DEP) in March 2005. Potential dates for snow making were derived from actual water withdrawal reports and are also plotted on the hydrographs.

Methodology:

The two USGS stream flow gages selected for analysis are Wild River at Gilead and Swift River near Roxbury. These two gages were selected because their location and mean basin elevation indicate they are the USGS gages that are most representative of rivers or streams that may be used as sources of water for snowmaking.

The six seasonal withdrawal thresholds proposed in DEP's draft water use rules were estimated for the two USGS gages using the USGS regression equations for monthly median flow in Dudley (2003). While actual monthly statistics could have been used for the thresholds, the intent of this assessment is to duplicate the likely scenario for withdrawal at a previously ungaged site.

The six seasons and associated seasonal withdrawal thresholds proposed in the draft DEP rules are:

January 1 to March 15	February median
March 16 to May 15	April median
May 16 to June 30	June median
July 1 to September 15	August median
September 16 to November 15	October median
November 16 to December 31	December median

The Statewide equations for estimating monthly median flow at an ungaged site from Dudley (2003) are:

Regression equation	1-sigma average standard error of prediction
$Q_{\text{feb}} = 36.54 * A^{1.017} * \text{DIST}^{(-0.89)}$	-13.4 to 15.5
$Q_{\text{apr}} = 0.227 * A^{1.01} * 10^{(0.028 * \text{pptA})}$	-20.8 to 26.2
$Q_{\text{jun}} = 0.734 * A^{1.076}$	-22.5 to 29.0
$Q_{\text{aug}} = 0.152 * A^{1.12} * 10^{(1.31 * \text{SG})}$	-28.6 to 40.2
$Q_{\text{oct}} = 0.307 * A^{1.074} * 10^{(1.11 * \text{SG})}$	-25.8 to 34.8
$Q_{\text{dec}} = 12.00 * A^{1.00} * \text{DIST}^{(-0.513)}$	-13.1 to 15.0

where Q is the median flow for the month, A is the drainage basin area in square miles, $DIST$ is the distance from the coast as measured from a line defined in Dudley (2003), $pptA$ is the spatially averaged mean annual precipitation in the basin in inches, and SG is the fraction of the basin underlain by significant sand and gravel aquifer. There is a 68-percent probability that the true monthly median flow will lie within the range of the standard error of prediction of the estimated monthly median flow.

The basin characteristics for the two drainage basins above the USGS stream gages were determined using various GIS datasets, and are summarized in the table below:

Basin Characteristics						
		Area (sq mi)	Fraction aquifer	Distance from coast (mi)	Mean annual precipitation (in)	Mean elevation (ft)
Swift River near Roxbury		96.7	0.002	110	46.3	1856
Wild River at Gilead		70.0	0.005	94	47.5	1794

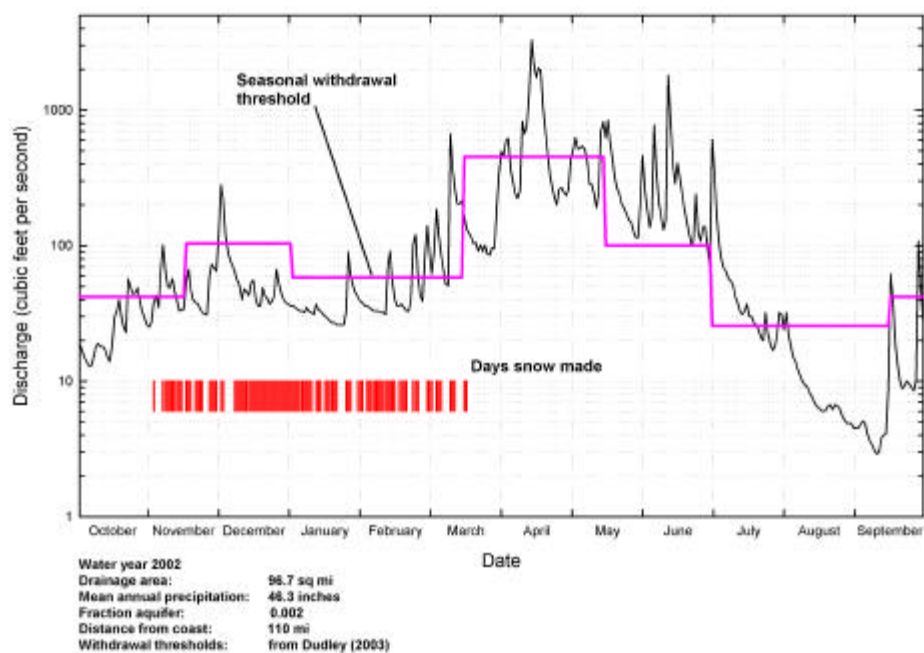
The estimated seasonal withdrawal thresholds are summarized in the table below:

			Swift River near Roxbury	Wild River at Gilead
Jan 1 to Mar 15	February median		58.27	48.17
Mar 16 to May 15	April median		454.68	354.47
May 15 to Jun 30	June median		100.47	70.96
Jul 1 to Sep 15	August median		25.61	18.01
Sep 16 to Nov 15	October median		41.87	29.84
Nov 16 to Dec 31	December median		104.13	81.63

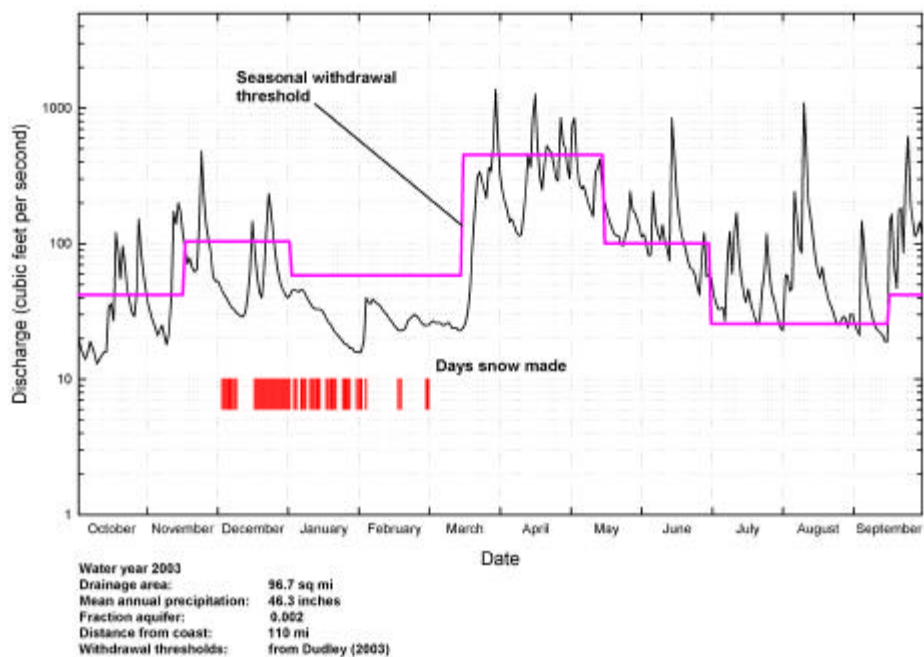
Days when the ski areas were actually withdrawing water and making snow were derived from actual water withdrawal reports for the 2001-2002 and 2002-2003 seasons.

The hydrographs on the next page show the daily stream flow at the two stream gage sites, the estimated seasonal withdrawal thresholds estimated from the equations in Dudley (2003), and the days the dates when snow making occurred.

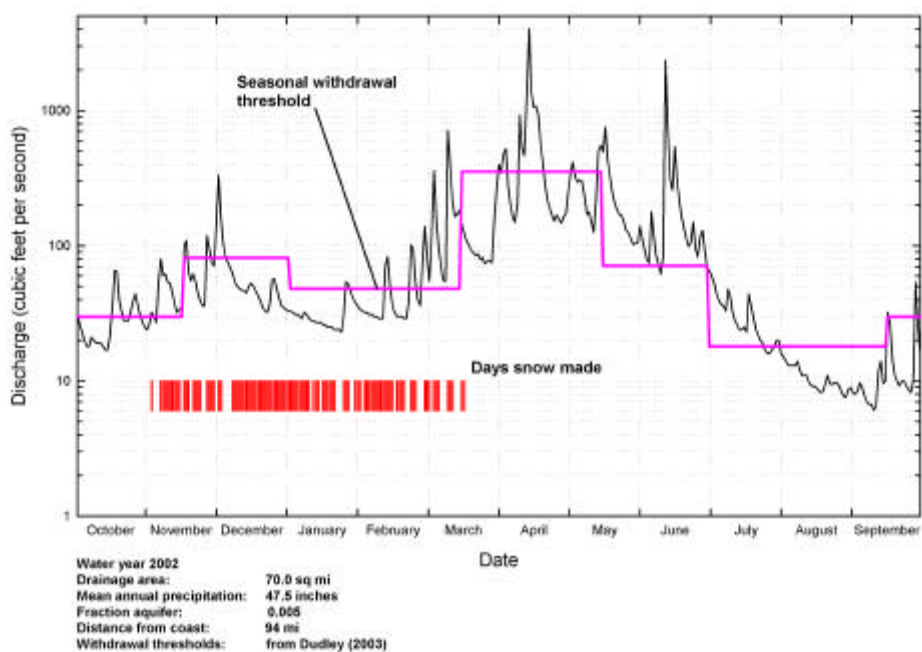
Swift River near Roxbury



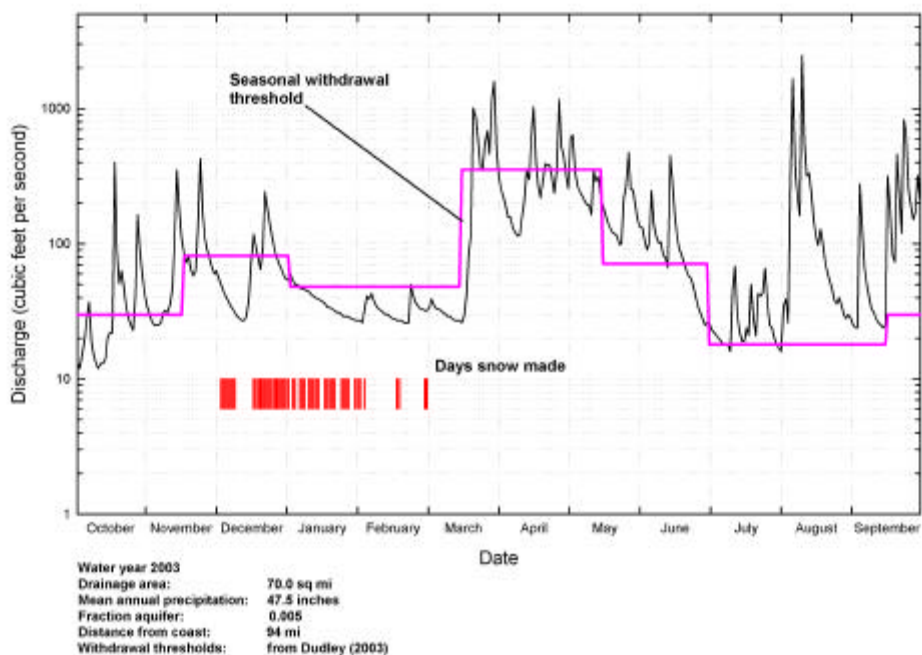
Swift River near Roxbury



Wild River at Gilead



Wild River at Gilead



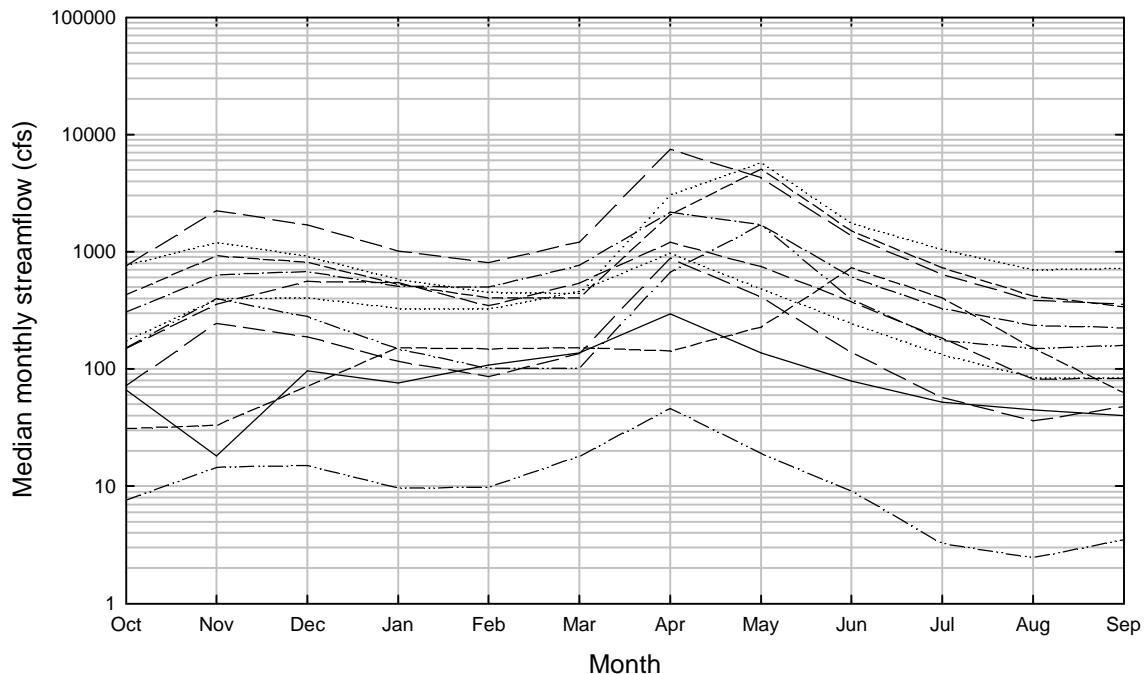
Results:

As can be seen in the two hydrographs, for much of the winters of 2001-2002 (water year 2002) and 2002-2003 (water year 2003), the daily flows in the Swift River near Roxbury and the Wild River at Gilead were below the proposed seasonal thresholds, particularly in December and January – peak snow making months.

In general, the selection of a median flow as a threshold guarantees that *on average* flows in the river or stream will be below the threshold 50-percent of the time. In drier and colder years when ground water discharge to the river is reduced, flows will be below the median a greater percent of the time.

The selection of the February median flow as the water withdrawal threshold allows for the maximum water withdrawal as typically the February median is the lowest winter median flow (figure below).

Median monthly streamflow for USGS gages



References:

Dudley, Robert W., 2003, Estimating Monthly, Annual, and Low 7-Day, 10-Year Streamflows for Ungaged Rivers in Maine, U.S. Geological Survey Scientific Investigations Report 2004-5026, 22p.